LUMASENSE™
TECHNOLOGIES

OPERATION MANUAL

Series IN 500
IMPAC Pyrometers
IN 510-N • IN 510 • IN 520-N • IN 520 • IN 530-N • IN 530

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1 General

1.1 Information about the user manual

Congratulations on choosing this high quality and highly efficient IMPAC pyrometer.

This manual provides important information about the instrument and can be used as a work of reference for installing, operating, and maintaining your pyrometer. It is important that you carefully read the information contained in this manual and follow all safety procedures before you install or operate the instrument.

To avoid handling errors, keep this manual in a location where it will be readily accessible.

1.1.1 Legend

	Note: The note symbol indicates tips and useful information in this manual. All notes should be read to effectively operate the instrument.
	Attention: This sign indicates special information which is necessary for a correct temperature measurement

1.1.2 Terminology

The used terminology corresponds to the VDI- / VDE-directives 3511, part 4.

1.2 Safety

This section offers an overview about important safety aspects.

1.2.1 General

Each person working with the pyrometer must have read and understood the user manual before operation. This also has to be done if the person has already used similar instruments or was already trained by the manufacturer.

The pyrometer is only to be used for the purpose described in the manual. It is recommended to use only accessories offered by the manufacturer.

1.2.2 Electrical connection

Follow common safety regulations for mains voltage (230 or 115 V AC) connecting additional devices operating with this mains voltage (e.g. transformers). Touching mains voltage can be fatal. An incorrect connection and mounting can cause serious health or material damages.

Only qualified specialists are allowed to connect such devices to the mains voltage.

1.3 Disposal / decommissioning

Inoperable IMPAC pyrometers must be disposed of in compliance with local regulations for electro or electronic material.

1.4 Limit of liability and warranty

All general information and notes for handling, maintenance and cleaning of this instrument are offered according to the best of our knowledge and experience.

LumaSense Technologies is not liable for any damages that arise from the use of any examples or processes mentioned in this manual or in case the content of this document should be incomplete or incorrect. LumaSense Technologies reserves the right to revise this document and to make changes from time to time in the content hereof without obligation to notify any person or persons of such revisions or changes.

All IMPAC Series 510, 520, and 530 instruments from LumaSense Technologies have a regionally effective warranty period. This warranty covers manufacturing defects and faults which arise during operation, only if they are the result of defects caused by LumaSense Technologies.

Disassembly of the instrument is not allowed. The warranty is VOID if the instrument is disassembled, tampered with, altered, or otherwise damaged without prior written consent from LumaSense Technologies; or if considered by LumaSense Technologies to be abused or used in abnormal conditions.

2 Introduction

2.1 Appropriate use

The **IN 510-N, IN 510, IN 520-N, IN 520, IN 530-N and IN 530** are stationary pyrometers for non-contact temperature measurement of non-metallic surfaces or painted, coated or anodized metals.

The versions IN 510, IN 520, and IN 530 are equipped with an illuminated LC display which shows the actual temperature reading. All available parameters can be set via the integrated keyboard. The types IN 510-N, IN 520-N, and IN 530-N do not have display and keyboard, they will be parametrized via interface.

The types 510 are equipped with sensor head and sensor cable for an ambient temperature of max. 85°C without cooling, types 520 and 530 are equipped with sensor head and sensor cable up to 180°C without cooling.

2.2 Components

Converter

Sensor Head

2.3 Accessories

Numerous accessories guarantee easy installation of the pyrometers. The following overview shows a selection of suitable accessories. You can find the entire accessory program with all reference numbers on section **8.3.2 Reference numbers accessories**.

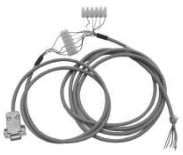
Mounting angle for sensor head

Air purge for sensor head 10:1 and 2:1

HT 6000:
Portable battery driven instrument for setting of pyrometer parameters

DA 6000:
Led digital display with possibility for setting of pyrometer parameters

Power supply NG DC 100...240 V AC ⇒ 24 V DC



Connecting cable with additional interface cable/plug

2.4 Unpacking the Instrument

Thoroughly inspect the instrument upon delivery to the purchaser. Check all materials in the container against the enclosed packing list. LumaSense Technologies cannot be responsible for shortages against the packing list unless a claim is immediately filed with the carrier. Final claim and negotiations with the carrier must be completed by the customer.

Save all packing materials, including the carrier's identification codes, until you have inspected the pyrometer and find that there is no obvious or hidden damage. Before shipment, the pyrometer was examined and has been tested. If you note any damage or suspect damage, immediately contact the carrier and LumaSense Technologies, Inc.

2.5 Transport, packaging, storage

In case the pyrometer is not put into service immediately, it should be tested in the application or simulated application as promptly as practical to reveal any hidden damage. Unpleasant surprises can be avoided by briefly trying any spare pyrometer before putting it in storage.

The instrument can be damaged or destroyed if shipped incorrectly. To transport or store the instrument, please use the original box or a box padded with sufficient shock-absorbing material. For storage in humid areas or shipment overseas, the device should be placed in welded foil (ideally along with silica gel) to protect it from humidity.

The pyrometer is designed for a storage temperature of -20 ... 70°C with non-condensing conditions. Other kind of storage can damage or malfunction the pyrometer.

2.6 Malfunction or Service Request

Contact LumaSense Technologies Technical Support in case of a malfunction or service request. Provide clearly stated details of the problem as well as the instrument model number and serial number. Upon receipt of this information, Technical Support will attempt to locate the fault and, if possible, solve the problem over the telephone.

If Technical Support concludes that the instrument must be returned to LumaSense Technologies for repair, they will issue a Return Material Authorization (RMA) number.

Return the instrument upon receipt of the RMA number, transportation prepaid. Clearly indicate the assigned RMA number on the shipping package exterior. Refer to Section 2.7, Shipments to LumaSense for Repair, for shipping instructions.

Technical Support can be contacted by telephone or email:

Santa Clara, California

- Telephone: (408) 727-1600 or 1-800-631-0176
- Email: support@lumasenseinc.com

Frankfurt, Germany

- Telephone: +49 69 97373 0
- Email: support@lumasenseinc.com

2.7 Shipments to LumaSense for Repair

All RMA shipments of LumaSense Technologies instruments are to be prepaid and insured by way of United Parcel Service (UPS) or preferred choice. For overseas customers, ship units air-freight, priority one.

The instrument must be shipped in the original packing container or its equivalent. LumaSense Technologies is not responsible for freight damage to instruments that are improperly packed.

Contact us to obtain an RMA number (if one has not already been assigned by Technical Support). Clearly indicate the assigned RMA number on the shipping package exterior.

Send RMA Shipments to your nearest technical service center:

Santa Clara, California	**Frankfurt, Germany**
LumaSense Technologies, Inc. 3301 Leonard Court Santa Clara, CA 95054 USA Telephone: (408) 727-1600 1-800-631-0176	LumaSense Technologies GmbH Kleyerstr. 90 60326 Frankfurt Germany Telephone: +49 69-97373 0
Email: support@lumasenseinc.com	**Email:** support@lumasenseinc.com

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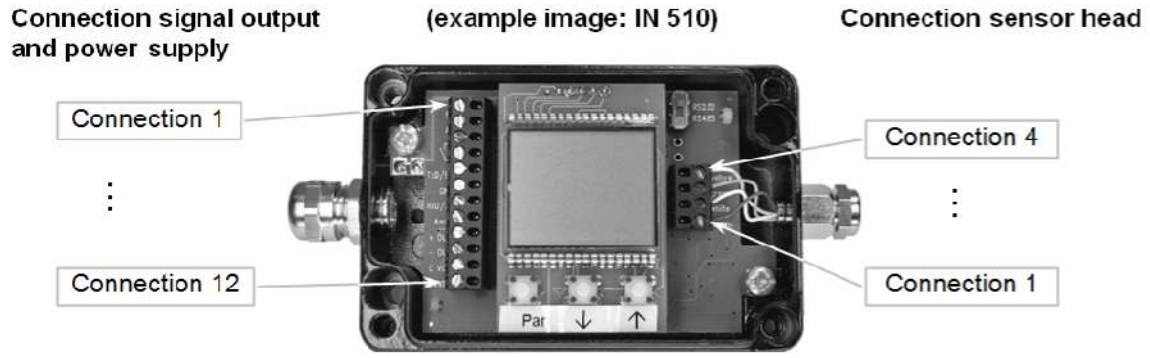
3 Installation

The pyrometers are powered by 24 V DC (possible range: 10 ... 30 V DC). When connecting the instrument to the power supply ensure correct polarity. To switch off the instrument the power supply has to be interrupted.

To meet the electromagnetic requirements (EMV), a shielded connecting cable must be used. The shield of the connecting cable (diameter: 3 - 6.5 mm, max. 12 wires) has to be connected only on the pyrometer's side. If the connecting cable is extended, the shield of the extension also needs to be extended. On side of the power supply (switch board) the shield must be open to avoid ground loops.



Connection signal output and power supply

1	RS485 „A2“	
2	RS485 „B2“	
3	Relay contact (isolated)	(pink)
4	Relay contact (isolated)	(grey)
5	RS232 interface TxD (RS485 „A1“)	(violet)
6	RS232 interface DGND	(red)
7	RS232 interface RxD (RS485 „B1“)	(black)
8	Sensor head temp. (connection to GND)	(blue)
9	Analog output mA or V or type K or type J (connection to GND)	(green)
10	GND (- OUT)	(yellow)
11	0 V	(brown)
12	+10 ... +30 V DC	(white)

Connection sensor head

4	NTC resistor	(yellow)
3	NTC resistor	(green)
2	Thermopile (+)	(white)
1	Thermopile (-)	(brown)

Notes:

- The sensor head is already connected to the converter (state of delivery).
- For differentiation between sensor heads of series 530 and series 520:
  530: resistor betw. 1 and 2: 80 kΩ
  520: resistor betw. 1 and 2: 20 kΩ

3.1 The connection cable

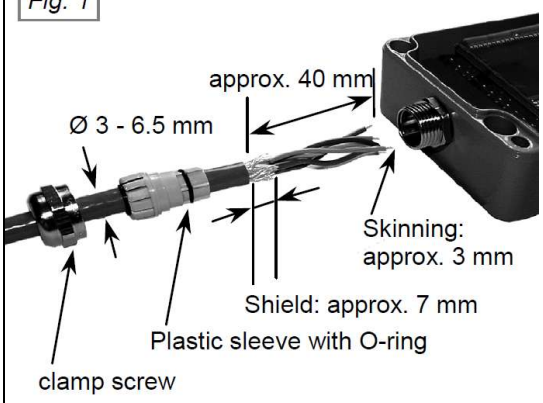
The connecting cable has to be selected according to the following criteria:

- Shielded
- Diameter 3 - 6.5 mm
- Quantity of wires: if necessary 2 to 12:

  - 2 for power supply.

  additionally, if required:
  - 1 for analog output
  - 1 for sensor head temperature
  - 1 GND for analogue output and / or sensor head temperature
  - 3 or 4 for digital interface
  - 2 for relay contact

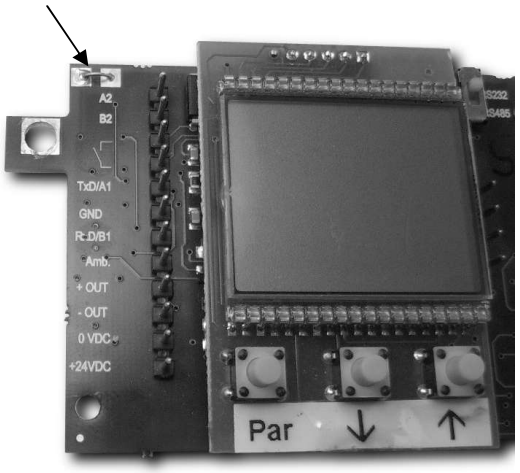
Fig. 1



3.2 The connection

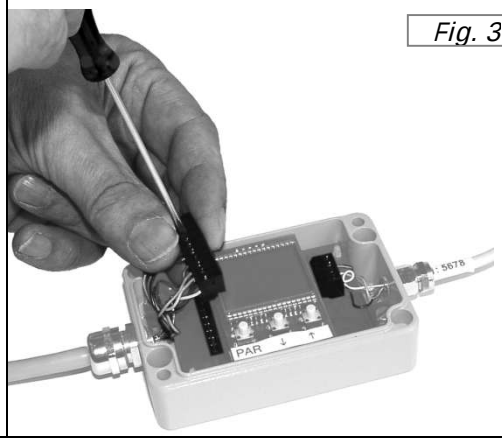
1. Prepare the cable as shown in *Fig. 1*.
2. The shielding of the connecting cable has to be pushed over the plastic sleeve 2 mm further than the O-ring.
3. Fix the cable with the clamp screw.
4. At state of delivery an internal connection between contact 11 and the housing exists. Should the housing have its own earth potential caused by an electric connection to an object, the internal connection has to be removed. *Fig. 2*.

Fig. 2



The screw bars inside the converter can be lifted up for easy installation of the wires (input/output cables and sensor head) *Fig. 3*.

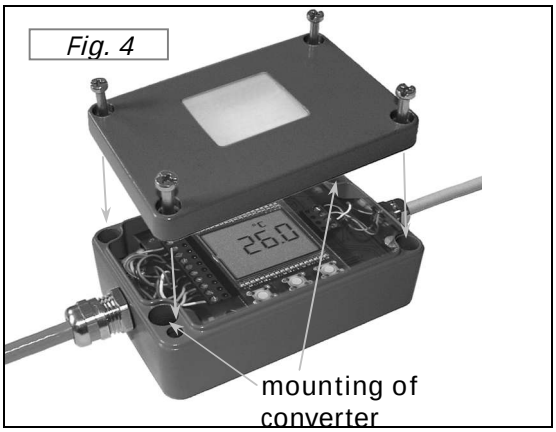
Fig. 3



⚠ **Caution:** Before connecting the pyrometer to other instruments (e.g. controller, PLC, etc.) the correct analog output (current, voltage or thermocouple), corresponding to the input of the instrument, has to be adjusted at the converter. A wrong output might damage the connected instrument.

Fig. 4 : For mounting of the converter housing, there are two holes with 4 mm screws.

After mounting, connecting cables and parametrizing (if necessary), close the cover of the converter and tighten the 4 screws.



Note: If using the pyrometer with measuring output thermocouple type K or J, this output has to be connected with the correct compensating cable.

3.3 Connecting to serial interface

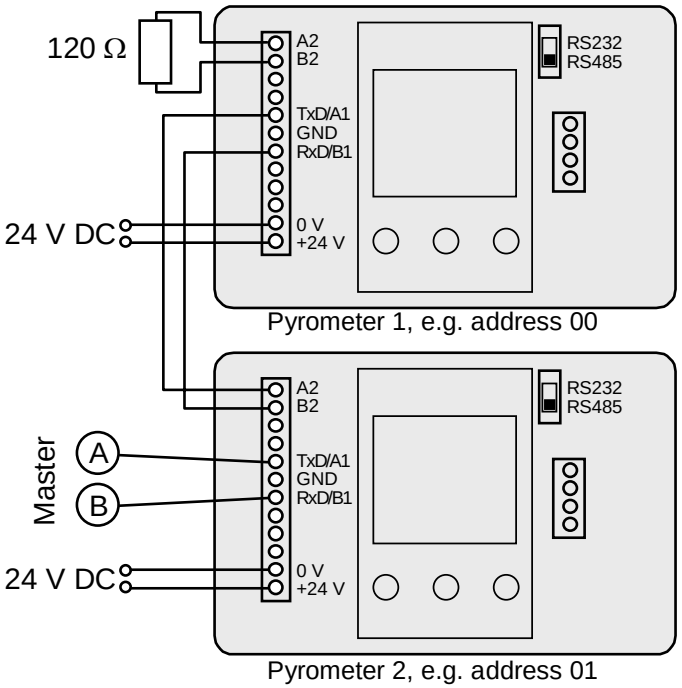
The pyrometers are equipped with a serial interface RS232 or RS485 (switchable at the pyrometer). Only short distances can be transmitted with RS232 and electromagnetic interferences can affect the transmission. With RS485 the transmission is to a large extent free of problems. Long transmission distances can be realized and several pyrometers can be connected in a bus system.

The transmission rate (in baud) of the serial interface is dependent on the length of the cable. Values between 1200 and 19200 Bd may be set.

Typical cable length for RS232 at 19200 Bd is 7 m.

Typical cable length for RS485 at 19200 Bd is 2 km.

Connection example of 2 instruments with RS485:



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4 Optics

4.1 Sensor head

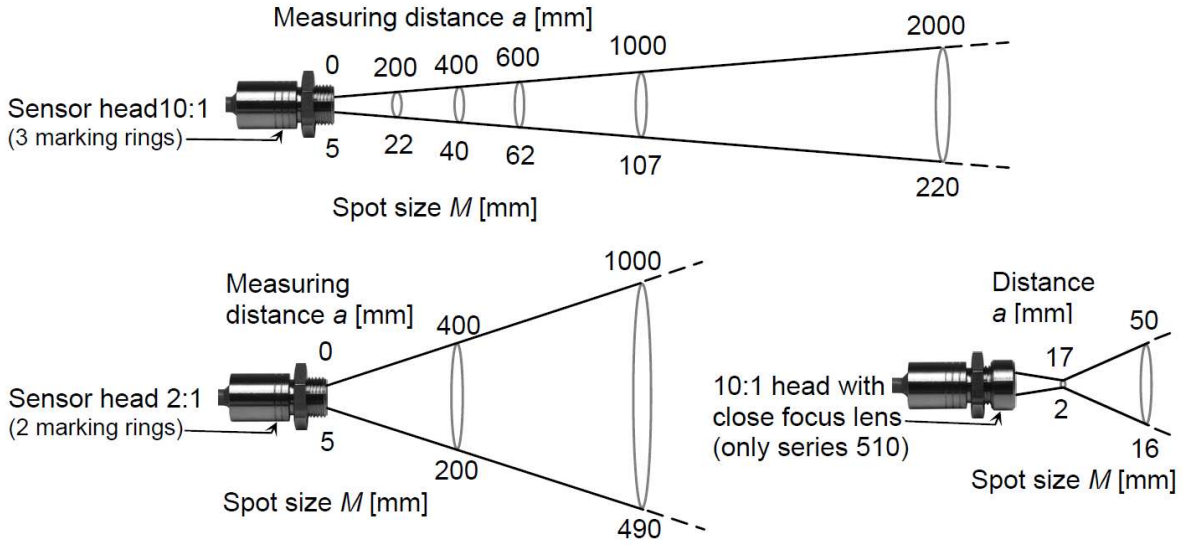
Two different optical head types with a field of view 10:1 or 2:1 are available. The spot sizes at different measuring distances are shown in the drawings below; intermediate values have to be interpolated. An additional close focus lens is available for the 10:1 head of series 510 instruments (temperature resistant up to 85°C) that can be used to generate a small spot size in a short distance.

4.1.1 Exchangeability of Sensor heads

Whether a sensor head can be used with a different electronic box is indicated by the identifier "S1" on the sensor cable:

- IN 500: optical heads 2:1 (S1 0xxx) and 10:1 (S1 1xxx) can be used with any electronic box.
- IN 510: optical heads 2:1 and 10:1 (both S1 0xxx) can be used with any electronic box.
- IN 520: optical heads 2:1 and 10:1 (both S1 2xxx) can only be used with IN 520 electronic boxes
- IN 530: optical heads 2:1 and 10:1 (both S1 4xxx) can only be used with IN 530 electronic boxes

When connecting a new sensor head to the electronic box, the respective 8-digit pin-code has to be set (see section **4.2 Exchange of sensor head**).

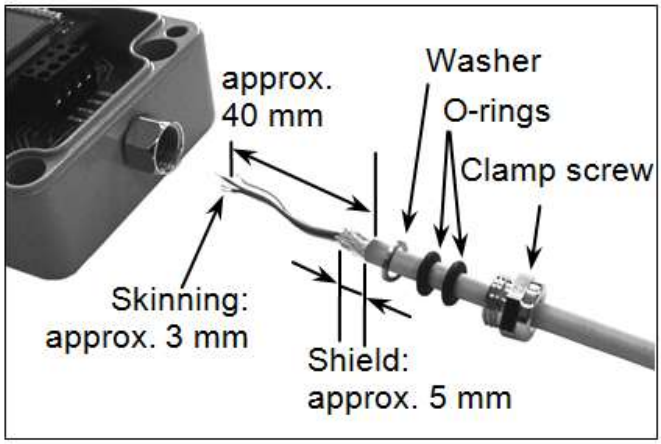


Note: The pyrometer can measure objects at any distance but the farther the distance, the larger is the measuring area (spot size). The object has to be bigger or at least as big as the spot size of the pyrometer in the measuring distance.

4.2 Exchange of sensor head

Note: Whether a sensor head can be used with a different electronic box is indicated by the identifier "S1" on the sensor cable. See section 4.1.1 for more information.

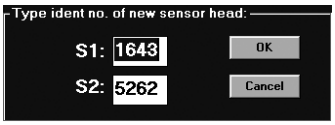
The sensor head is exchangeable if a sensor head with other optical data or a longer cable is required. Each sensor head cable is marked with a label containing a sensor code which has to be set in the pyrometer.



The sensor head cable is available in lengths of 3 or 15 m which can be cut to any required length. The sensor code label should be affixed to the remaining part of the cable.

The cable has to be prepared in accordance with the illustration. The shield must be pushed above the washer and O-rings, then the cable can be pushed into the converter and fixed with the clamp screw (series 510) or soldered to the pins (series 520 and series 530). (For cable connection see schematic in section **3**, **Installation**).

The sensor code at the cable has to be set in the pyrometer as follows:



- Setting via software: Set these codes S1 and S2 in **"Pyrometer parameters"** under the button Exchange sensor head and confirm them with "**OK**". Now the new sensor head is matching to the converter and the pyrometer is ready for measuring.
- Additionally in the IN 510, IN 520, or IN 530 the setting of the sensor head codes can be done via internal push buttons: Remove the cover of the converter and press the buttons ⇑ and ⇓ simultaneously. While pressing these two buttons push the "**PAR**" button too. The display shows code S1. With the arrow buttons ⇑ and ⇓ the new code S1 has to be set and confirmed with the "**PAR**" button. Now code S2 appears on the display and has to be set and confirmed in the same way.
- A setting of these codes with the HT 6000 or digital display DA 6000 is not possible.

4.3 Error messages at non-specified sensor temperatures

The pyrometer gives the following error messages for the protection of the electronics and the machines if the temperature of the sensor head is out of specified values:

- Excess of specified sensor head temperature (corresponding to the model: 85°C or 180°C):
  - Output of the serial interface code 75550
  - Output of the analog output: 22 mA at 0/4 ... 20 mA, 5 V at 0 ... 5 V, excess of end of measuring range at thermocouple output
  - The relay is de-energized (contact open)
  - Display of IN 510, IN 520, or IN 530: ERR 1 instead of the temperature reading
- Sensor head temperature falls below specified value (0°C):
  - Output of the serial interface code 74440
  - Output of the analog output: 22 mA at 0/4 ... 20 mA, 5 V at 0 ... 5 V, excess of end of measuring range at thermocouple output
  - The relay is de-energized (contact open)
  - Display of IN 510, IN 520 or IN 530: ERR 2 instead of the temperature reading

There is no error message if the converter temperature runs out of its specified operating temperature.

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5 Device Settings

5.1 Parameters

The setting of the parameters of the **IN 510-N, IN 520-N,** or **IN 530-N** can only be done via serial interface (see also section **6, Settings via interface and software** and section **5.3 Settings with HT 6000 (accessory)**), the parameters of the **IN 510, IN 520,** and **IN 530** additionally can be done by integrated push buttons inside the converter (see section **5.2 Settings at the instrument**).

5.1.1 Emissivity (EMI)

For a correct measurement, it is necessary to adjust the emissivity. This *emissivity* is the relationship between the emission of a real object and the emission of a black body radiation source (this is an object which absorbs all incoming rays and has an emissivity of 100%) at the same temperature.

Different materials have different emissivities ranging between 0% and 100% (settings at the pyrometer between 10 and 100%, an additional attenuation, setting from 100 to 120% can be used for example to correct the measurement of objects behind gases with hot soot). Additionally the emissivity is dependent upon the surface condition of the material, the spectral range of the pyrometer and the measuring temperature. The emissivity setting of the pyrometer has to be adjusted accordingly.

Typical emissivity values of various common materials for the two spectral ranges of the instruments are listed below. The tolerance of the emissivity values for each material is mainly dependent on the surface conditions. Rough surfaces have higher emissivities.

Object	Emissivity (%)
" Black body furnace "	100
Human skin	98
Black dull varnish	95
Carbon soot	95
Wood	80 ... 92
Paper	92 ... 95
Asphalt	85
Glass / Quartz glass	72 ... 87
Textile	75 ... 95
Graphite	75 ... 92
Cement	90
Water	95

Object	Emissivity (%)
Brickwork	
Fire clay	
Rubber	
Porcelain	85 ... 95
Ceramics	
Varnish	
Plaster	
Oil paint	
Steel (oxidized)	60 ... 80
Steel (smooth)	10 ... 30
Aluminum (smooth)	2 ... 15
Aluminum (anodized)	96

5.1.2 Response time (T90)

Settings:
OFF
0.5 s
⋮
30 s

The response time is the time interval between the instant of an abrupt change in the value of the measuring temperature and the instant from which the measured value of the pyrometer remains within specified limits. The time is taken to reach 90% of the recorded temperature difference. In the OFF position, the device operates using his time constant (shortest response time). Longer response times can be used for the measurement of objects which have rapidly fluctuating temperatures to achieve constant temperature reading.

5.1.3 Clear time (TCL)

Settings:
OFF
0.1 s
⋮
25 s
extern
auto

The *maximum value storage* (or minimum value storage) stores the highest (or lowest) measurement value. The clear time defines the time period until the stored value is deleted and replaced by a new one.

The following settings are possible:

- Clear time "OFF": The storage is switched off and only momentary values are measured.
- If any clear time **TCL** is set either the maximum value or minimum value storage will be cleared.
- The "auto" mode is used for discontinuous measuring tasks. For example objects are transported on a conveyer belt and pass the measuring beam of the pyrometer only for a few seconds. Here the maximum (minimum) value for each object has to be indicated. In this mode, the maximum (minimum) value is stored until a new hot (or cold) object appears in the measuring beam. The temperature which has to be recognized as "hot" (or "cold") is defined by the low (high) limit of the adjusted sub range. The stored maximum value will be deleted when the temperature of the new hot object exceeds the low limit **LO** of the sub range by 1% or at least 2°C. The stored minimum value will be deleted when the object temperature falls below the high limit **HI** of the sub range by 1% or at least 2°C.
- The external clearing ("extern") of the storage can only be activated and used with an own software (see data format **UPP®**, section **8.1**).

5.1.4 Selection of the maximum or minimum value storage (MAX or MIN)

Settings:
MAX
MIN

With this setting you choose between maximum or minimum value storage if the storage function is activated by setting **TCL**. If TCL is switched "OFF", the storage function is not activated, the indication of "MAX" or "MIN" only shows the preselection.

5.1.5 Subrange (LO / HI)

Settings:
700°C
⋮
-40°C

You have the opportunity to choose a subrange (minimum 51°C) within the basic measuring range of the pyrometer. This subrange corresponds to the analog output. **LO** describes the beginning of this measuring range, **HI** the end of the range. If the thermocouple output is used, the analog output does not change. In addition, with the setting of a subrange it is possible to fulfill the requirements of the "auto" clear mode of the maximum or minimum value storage (see above).

5.1.6 Analog output (OUT)

The analog output has to be selected according to the signal input of the connected instrument (controller, PLC, etc.). You can choose between current output (0 or 4 to 20 mA), voltage output (0 to 5 V) or thermocouple output type J or K.

Settings:
0-20 mA
4-20 mA
0-5 V
type J
type K

Caution: Before connecting the pyrometer to other instruments (e.g. controller, PLC, etc.) the correct analog output (current, voltage or thermocouple), corresponding to the input of the instrument, has to be adjusted in the converter. A wrong output might damage the connected instrument.

5.1.7 Temperature display (°C / °F)

Settings:
°C
°F

The temperature can be displayed in °C or °F.

5.1.8 Compensation of ambient temperature (CMP)

Settings:
700°C
⋮
-40°C
auto

This compensation is used for a very few special applications only. The standard setting of this parameter is "auto", because the temperature of the sensor head is normally the ambient temperature of the measured object. Should the measured object be placed in an area with a higher ambient temperature (e.g. inside a furnace), the measurement might be falsified (probably too high temperature indication). This influence can be compensated by presetting of the ambient temperature of the object with help of the CMP-function (presetting within the measuring range of the instrument). It has to be considered, that this method only improves the results if the ambient temperature at the place of the measured object is always constant.

5.1.9 Sensor head temperature (AMB)

The temperature of the sensor head can be displayed.

5.1.10 Baud rate (BD)

Settings:
19200 Bd
⋮
1200 Bd

The transmission rate of the serial interface in Baud (Bd) is dependent on the length of the cable. The standard cable length with RS232 for 19200 Bd is 7 m, with RS485 2 km. The baud rate is reduced by 50% if the transmission distance is doubled.

5.1.11 Address (AD)

Settings:
31
⋮
00

For connecting several pyrometers with RS485 (up to 32) with one serial interface, it is necessary to give each instrument an individual address for communication. First it is necessary to connect each single instrument to give it an address. After that, all instruments can be connected and addressed individually. If parameters may be changed simultaneously on all pyrometers, the global **address 98** can be used. This allows you to program all pyrometers at the same time, regardless of the addresses that have already been assigned. If the address of a pyrometer is unknown, it is possible to communicate with it using the global **address 99** (connect only one pyrometer).

5.1.12 Limit switch (LIM)

Settings:
700°C
⋮
-40°C

The instruments are equipped with a relay contact, controlled by the measuring signal. The switch point of this relay is adjustable with the function "**LIM**" within the measuring range. The relay contact is closed below the adjusted value, it is open above it.

5.1.13 Hysteresis (HYS)

The relay contact opens immediately when the temperature exceeds the adjusted "**LIM**" value, it closes only if the temperature falls below a value which consists of "**LIM**" and the adjusted hysteresis.

Settings:
20°C
⋮
2°C

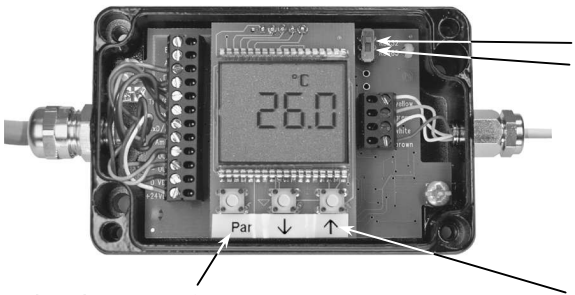
5.1.14 Wait time (only available via interface commands, see section 8.1, Data format UPP®)

When using a pyrometer with RS485, it is possible that the connection is not fast enough to receive the pyrometer's answer to an instruction of the master. In this case, a wait time can be set to slow down the data transfer (e.g.: tw = 02 at a baud rate 9600 means a wait time of 2/9600 sec).

Standard settings at delivery:
EMI=100; **T90**=OFF; **TCL**=OFF; **MAX/MIN**=MAX; **OUT**=0...20 mA; **LO**=0°C;
HI=500°C; **°C/°F**=°C; **CMP**=auto; **BD**=19200; **AD**=00; **LIM**=0°C; **HYS**=2°C

5.2 Settings at the instrument (only IN 510, IN 520, and IN 530)

The buttons for parametrizing the IN 510, IN 520 or IN 530 are inside the converter and are accessible after removing the cover (4 screws).



Interface switch:
RS232
RS485

Selection of parameters: the parameters are called with the button **PAR** (the sequence is described on section 5). If no button is pushed for approx. 15 s, the instrument switches back to measuring mode with the latest parameter settings. A changed value of a parameter is automatically stored after changing to another parameter.

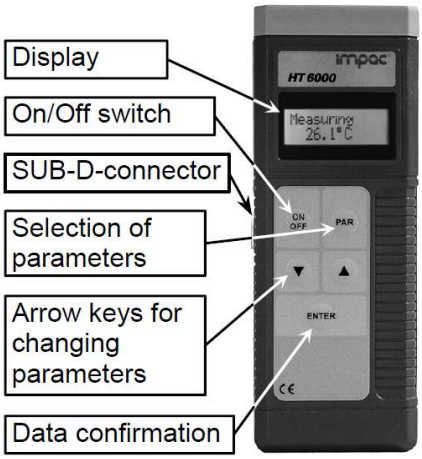
Up / down buttons (↑ ↓): After selection of one parameter with the PAR button the up / down buttons are used to set the available values.

Note: Do not operate the converter permanently with open cover.

5.3 Settings with HT 6000 (accessory)

The HT 6000 is a portable battery driven instrument for the parameter setting of digital pyrometers and for indication of temperature.

The pyrometer has to be connected to the HT 6000 via its interface cable (RS232 or RS485) with the female SUB-D connector. When the HT 6000 is switched on it recognizes the pyrometer automatically and the preset parameters can be displayed. With the "**PAR**" button the different parameters can be called in the sequence described on section **5.1 Parameters**. With the arrow buttons and the values of the parameters can be selected and confirmed with the "**ENTER**" button. If no button is pressed for 30 s the HT 6000 changes to the temperature indication **without accepting the changed value**.



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6 Settings via interface and software

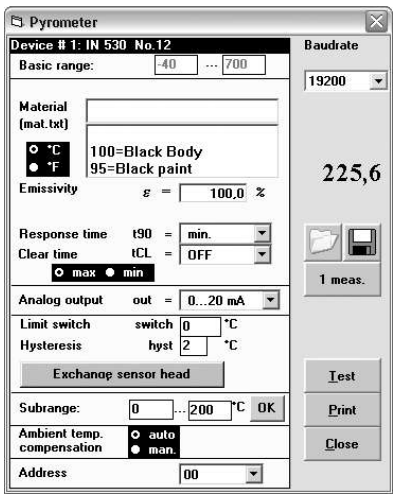
The entire parameters are adjustable via serial interface and PC software *InfraWin* (latest version is available as download from the homepage www.lumasenseinc.com; min. system requirements Windows 98 SE) or via self created user communication software (see UPP® table, section 8.1).

After installation of the software (select the setup program and follow the installation instructions) and start of *InfraWin*, the start menu allows access to the several program function:

Open file	Opens a saved file
Save as	Storage of measured values for further processing
Measurement (color bar)	Online measurement with color bar display
Measurement (online trend)	Online measurement with graphic display
Pyrometer parameters	Setting of the parameters of the instrument
Computer (COM, Addr)	Setting of interface, baud rate and pyrometer addresses (RS485)
PC sampling rate	Time interval between two measurements
1 Number of devices	Number of connected instruments (max. 2)
Output listing	Listing of measured or stored values in tabular form
Output trend	Processing of measured (stored) readings in graph form
Output .TXT file	Processing of measured (stored) readings in a text file
Calculate spot size	Calculation of spot sizes in various measuring distances
PI 6000 Controller	Only if available: controls the programmable controller PI 6000

Before using the software, the serial interface(s) connected to the pyrometer(s) has (have) to be selected under the **Computer** icon.

Afterwards all preset **pyrometer parameters** can be displayed and modified.



The window **pyrometer parameter** contains all parameter settings described in section 5.1. Choose the correct setting for your application, the actual setting is displayed.

Notes:

- "Basic range" displays the total range of the pyrometer automatically and cannot be changed.
- If you select a clear time longer than 0 s (OFF) you have to choose "max" or "min" in the next line to define either maximum value storage or minimum value storage.
- If it is necessary to activate the ambient temperature compensation, you have to switch to "man". Then the

small window T(Amb) appears and the temperature correction can be done. In position "auto" it is assumed that the ambient temperature of object and sensor head is the same (standard setting).

- Under "Material" you have the possibility to store the names of different measuring objects with their emissivity values and to recall them from the list.
- "1 meas." shows the current measuring temperature in the pyrometer parameters window for approx. 1 second.
- "Test" opens a window that allows the direct communication with the pyrometer via the interface commands (see section 8.1 **Data format UPP®**). Additionally a connection test with the preset baud rate can be done.
- Via the "open/save" symbols all settings can be stored and restored.
- Further program functions are described in the online help of the software.

7 Maintenance

7.1 Safety

Attention during pyrometer services:

Should the pyrometer be integrated in a running machine process, the machine has to be switched off and secured against restart before servicing the pyrometer.

7.2 Service

The pyrometer does not have any parts which require regular service, only the lens has to be kept clean. The lens can be cleaned with a soft cloth in combination with alcohol (do not use acid solutions or dilution). Also standard cloths for cleaning glasses or photo objectives can be used.

The lens of the 10 : 1 sensor head has an anti-reflective coating which appears slightly colored. Be extremely careful - this layer can easily be rubbed off - this will greatly affect the measuring results!

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8 Appendix

8.1 Data format UPP® (Universal Pyrometer Protocol)

Via interface and suitable communication software or via “Test” function of the *InfraWin* software (section “pyrometer parameters”) commands can be exchanged directly with the pyrometer.

The data exchange occurs in ASCII format with the following transmission parameters:

The data format is: 8 data bits, 1 stop bit, even parity (8,1,e)

The device responds with the entry of a command with: output (e.g. the measuring value) + CR (**C**arriage **R**eturn, ASCII 13), with pure entry commands with "ok" + CR. With invalid commands the instruments answers with „no“ + CR.

Every command starts with the 2-digit device address AA (e.g. "00"). This is followed by 2 small command letters (e.g. "em" for level of emissivity ε), finished with CR

This is followed, if necessary for that command, by the ASCII parameter "X". If this parameter "X" is omitted, then the device resets with the current parameter.

Example: Entry: “00em“ + <CR>

The emissivity setting of the device with the address 00 is returned

Answer: “0970“ + <CR> means emissivity = 0.970 or 97.0%

Description	Command	Parameters
Reading measuring value:	AAms	Output: YYYYY; 5-digit decimal, in $^1/_{10}$ °C or °F 88880 = temperature-overflow 75550 = exceed max. sensor head temp. 74440 = fall below min. sensor head temp. 02563 = 256.3 °C or °F; -0170 = -17.0 °C or °F
repeatedly reading measuring values:	AAmsXXX	XXX = 000 ... 999 XXX = Number of measuring values
Emissivity:	AAemXXXX	XXXX = 0100 ... 1200 in ‰
Response time t_{90}:	AAezX	X = 0 ... 6 (decimal) **0** = intrinsic time constant of the device 1 = 0.5 s 2 = 1 s 3 = 2 s 4 = 5 s 5 = 10 s 6 = 30 s
Setting clear time t_{CL}:	AAlzX	X = 0 ... 8 (decimal) **0** = Max. value- / min. value storage off 1 = 0.10 s 5 = 5.00 s 2 = 0.25 s 6 = 25.00 s 3 = 0.50 s 7 = external clearing 4 = 1.00 s 8 = automatic clearing
External clearing:	AAlx	Simulation of an external reset contact
Setting maximum / minimum value:	AAmiX	X = desired setting 0 = maximum value, 1 = minimum value
Read. max/min value:	AAmi	Output: 0 or 1; 0 = max value, 1 = min value
Reading basic measuring range:	AAmb	Output: YYYYZZZZ (8-digit hex) [2] YYYY = beginning of measuring range ZZZZ = end of measuring range
Reading sub range:	AAme	as with mb
Setting sub range:	AAm1YYYYZZZZ	YYYY = beginning of measuring range ZZZZ = end of measuring range
Analog output [1]:	AAasX	X = 0 ... 4 2 = 0 ... 5 V **0** = 0 ... 20 mA 3 = thermocouple type K 1 = 4 ... 20 mA 4 = thermocouple type J
Temperature display [1]:	AAfhX	X = 0;1 **0** = Output Celsius 1 = Output Fahrenheit
Reading ambient temperature:	AAut	Output: stored value, 4-digit hex [2] e.g. 0258 corresponds to 600 degrees
Entering ambient temperature:	AAutXXXX	XXXX = Value of ambient temp., 4-digit hex [2] XXXX z.B. FFEC corresponds to -20 degrees -99_{dez} = $FF9D_{hex}$ means: automatic, no manual compensation
Sensor head temp.:	AAgt	Output: XXX (dec. 000...180°C or 032...356°F)
Max. sensor head temp.:	AAtm	Output: XXX (dec. 000...180°C or 032...356°F)
Baud rate:	AAbrX	X = 0 ... 4 0: 1200 bd 1: 2400 bd 2: 4800 bd 3: 9600 bd **4**: 19200 bd
Instrument address [1]:	AAgaXX	XX: device address decimal; **00** ... 31 variable device addresses; global: 98, 99
Reading switch point:	AAsl	Output: XXXX (4-digit hex) [2]
Setting switch point:	AAslXXXX	XXXX (4-digit hex) [2]; adjustable within sub range

Reading hysteresis:	AAhlXX	XX (2-digit hex) [2]; XX setting 2 ... 20°C (4 ... 36°F)
Setting hysteresis:	AAhl	Output: XX (2-digit hex) [2]
Wait time:	AAtwXX	XX = 00 ... 99 relative delay value
Reading sensor data:	AAse	Output: XXXXYYYY (8-digit decimal); Reading of adjusted sensor data: XXXX: S1; YYYY: S2
Setting sensor data:	AAseXXXXYYYY	XXXXYYYY (8- digit dec.); entering sensor data
Reset [1]:	AAre	Reset device
Reading parameters:	AApa	Output 11-digit decimal: Digit 1 and 2 (10...99 or **00**): EMI up to 100 Digit 3 (**0** ... 6): t_{90} (response time) Digit 4 (**0** ... 8): t_{CL} (storage clear mode) Digit 5 (**0** / 4): analog output Digit 6 and 7 (00 ... 99): sensor head temp. Digit 8 and 9 (**00** ... 31): device address Digit 10 (0 ... **4**): device baud rate Digit 11 (always 0)
Error status:	AAfs	Output: XX; XX=00…FF (00 = no error) (01…FF: error code for LumaSense service)
Serial number:	AASsn	Output: XXXXX (5-digit decimal)
Type / software version:	AAve	Output: XXYYZZ (6-digit decimal) XX = 76 (IN 510, IN 520, IN 530); YY = Month of software version ZZ = Year of software version

Notes: - the letter “l” means the lower case letter of “L” - bold values = default settings

- After entering these commands the device carries out an automatic reset. The device needs approx. 150 ms before it is ready to use and work with the changed settings.
- The input and output corresponds to the preset degree C or degree F.

Additional instruction for the RS485 interface

Requirements to the master system during half-duplex operation:

1. After an inquiry, the bus should be switched into a transmission time of 3 bits (some older interfaces are not fast enough for this).
2. The pyrometer's response will follow after 5 ms at the latest.
3. If there is no response, there is a parity or syntax error and the inquiry has to be repeated.

After receiving the response, the master has to wait at least 1.5 ms before a new command can be entered.

8.2 Technical Data

Temperature range:	-40 ... 700°C (-40 ... 1292°F)
Sub range:	Factory setting: 0 ... 500°C; user adjustable (minimum span: 51°C)
Data handling:	Digital

Spectral range:	8 ... 14 µm (for measurement of non-metallic or coated metallic objects)
Sensor head:	Optics **10:1**: with lens; optics **2:1**: without lens
IR detector:	Thermopile

Power supply:	10 ... 30 V DC ripple < 0.5 V power consumption: max. 60 mA
Analog output:	Linear current (0/4 ... 20 mA), voltage (0 ... 5 V) or thermocouple (type „J“ or „K“)
Additional output:	10 mV/°C or 10 mV/°F for temperature of sensor head
Load:	Max. 700 Ω / 24 V power supply (for current output) (500 Ω/20 V)
Output impedance:	100 Ohm (for thermocouple or voltage output)
Relay contact:	Isolated relay contact; 50 V DC; 0.2 A
Hysteresis:	Negative hysteresis, 2 - 20°C adjustable (without current or value exceeded = open contact)
Digital interface:	Switchable: RS232 or addressable RS485 (half duplex) baud rate 1200 up to 19200 Bd, resolution 0.1°C
Isolation:	Non isolated analog outputs and power supply (relay contact isolated)

Emissivity (EMI):	10 ... 120% adjustable in steps of 0.1%
Max. / Min. value storage:	Clear time OFF; 0.1 s; 0.25 s; 0.5 s; 1 s; 5 s; 25 s; extern; auto
Response time t_{90}:	180 ms; switchable: 0.5; 1; 2; 5; 10 or 30 s
Temperature display (only IN 510, IN 520 and IN 530):	LCD, 4 digit, 3 values per second, permanent display illumination
Exceeding of measuring range:	Display 8888
Fall below measuring range:	Display: 1°C below sub range
Resolution:	1/10°C (1/10°F from -40 to 999.9°F; 1°F from 1000 to 1292°F)

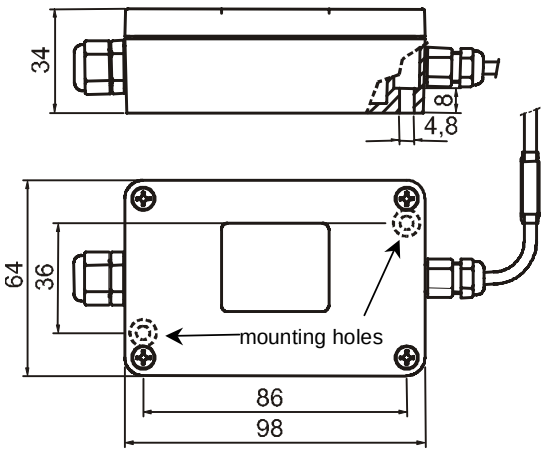
Uncertainty **) Dependent on object temperature T and ambient temperature $T_{amb.}$ (EMI = 1, t_{90} = 1 s): **) With thermocouple output minimum 2.5°C	T = 0...700°C: 0.8% or 1°C *) T = 0...-20°C: 2°C T = -20...-40°C: 3°C T_K of uncertainty: 0.03%/°C or 0.05°C/°C at 25°C ambient temperature $T_{amb.}$ *) *) Whichever value is greater. The instrument must be at a constant ambient temperature for a minimum of 15 minutes ⚠ A correct temperature measurement is impossible if the temperature of the object is more than 85°C below the sensor head temperature (temperature reading is too high, no error message)
Repeatability:	0.5% of measured value °C or 0.5°C whichever value is greater, ambient temperature is constant
Noise Equivalent Temperature Difference (NETD):	with t_{90} = 180 ms: 0.1°C (σ = 1) (measured temperature = 23°C and emissivity = 1)

Ambient temperature converter:	0 ... 65°C
Storage temperature converter:	-20 ... 70°C
Ambient temperature of sensor head:	IN 510-N and IN 510: 0 ... 85°C IN 520-N and IN 520: 0 ... 180°C with cooling / purging unit: 0 ... 200°C IN 530-N and IN 530: 0 ... 180°C (short-time 210°C) with cooling / purging unit: 0 ... 200°C
Storage temperature of sensor head:	-20 ... 85°C (IN 510-N, IN 510) -20 ... 180°C (IN 520-N, IN 520) -20 ... 180°C (IN 530-N, IN 530)
Relative humidity:	10 ... 95%, non condensing
Protection class:	IP65 (converter, sensor head 10:1, 180°C-sensor head 2:1) IP20 (85°C-sensor head 2:1)

Weight:	320 g
Dimensions:	Converter: 98 mm x 64 mm x 34 mm (L x B x H) Sensor head: 28 x 14 mm (L x Ø), thread M12 x 1, L=10.8 mm
Housing:	Aluminum (converter), stainless steel (sensor head)
Operating position:	Any
CE Approval / EMV tests:	According to EU directives about electromagnetic immunity

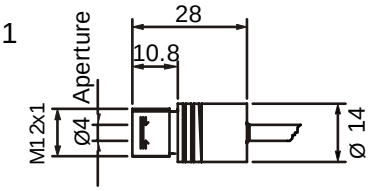
8.2.1 Dimensions

Converter:



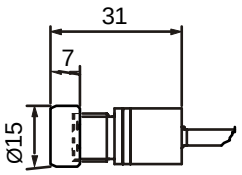
Sensor heads:

Sensor head 10:1

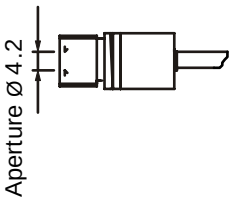


Cable-Ø: approx. 3 mm (types 530)
approx. 4 mm (types 510)

Sensor head 10:1
with close focus lens



Sensor head 2:1



8.2.2 Scope of delivery

Instrument, one sensor head with cable length of 3 m or 15 m cable, works certificate, operation manual.

Note: A connection cable is not included with the instrument and has to be ordered separately (see section **8.3 Reference numbers**).

8.3 Reference numbers

8.3.1 Reference numbers instruments

3 874 360	IN 510	with sensor head 2:1	(85°C ambient temperature),	3 m cable
3 874 370	IN 510	with sensor head 2:1	(85°C ambient temperature),	15 m cable
3 874 460	IN 510	with sensor head 10:1	(85°C ambient temperature),	3 m cable
3 874 470	IN 510	with sensor head 10:1	(85°C ambient temperature),	15 m cable
3 874 160	IN 510-N	with sensor head 2:1	(85°C ambient temperature),	3 m cable
3 874 170	IN 510-N	with sensor head 2:1	(85°C ambient temperature),	15 m cable
3 874 260	IN 510-N	with sensor head 10:1	(85°C ambient temperature),	3 m cable
3 874 270	IN 510-N	with sensor head 10:1	(85°C ambient temperature),	15 m cable
3 874 380	IN 520	with sensor head 2:1	(180°C ambient temperature),	3 m cable
3 874 390	IN 520	with sensor head 2:1	(180°C ambient temperature),	15 m cable
3 874 480	IN 520	with sensor head 10:1	(180°C ambient temperature),	3 m cable
3 874 490	IN 520	with sensor head 10:1	(180°C ambient temperature),	15 m cable
3 874 180	IN 520-N	with sensor head 2:1	(180°C ambient temperature),	3 m cable
3 874 190	IN 520-N	with sensor head 2:1	(180°C ambient temperature),	15 m cable
3 874 280	IN 520-N	with sensor head 10:1	(180°C ambient temperature),	3 m cable
3 874 290	IN 520-N	with sensor head 10:1	(180°C ambient temperature),	15 m cable
3 874 550	IN 530	with sensor head 2:1	(180°C ambient temperature),	3 m cable
3 874 560	IN 530	with sensor head 2:1	(180°C ambient temperature),	15 m cable
3 874 570	IN 530	with sensor head 10:1	(180°C ambient temperature),	3 m cable
3 874 580	IN 530	with sensor head 10:1	(180°C ambient temperature),	15 m cable
3 874 500	IN 530-N	with sensor head 2:1	(180°C ambient temperature),	3 m cable
3 874 510	IN 530-N	with sensor head 2:1	(180°C ambient temperature),	15 m cable
3 874 520	IN 530-N	with sensor head 10:1	(180°C ambient temperature),	3 m cable
3 874 530	IN 530-N	with sensor head 10:1	(180°C ambient temperature),	15 m cable

8.3.2 Reference numbers accessories

3 821 010	Connection cable 2 m, 10 wire, with additional digital cable (1 m) and *InfraWin* analyzing and reporting software
3 821 020	Connection cable 2 m, for power supply and thermocouple output (compensating cable)
3 874 830	Sensor head 2:1 for IN 510, sensor cable 3m
3 874 840	Sensor head 2:1 for IN 510, sensor cable 15m
3 874 860	Sensor head 10:1 for IN 510, sensor cable 3m
3 874 870	Sensor head 10:1 for IN 510, sensor cable 15m
3 874 780	Sensor head 2:1 for IN 520, sensor cable 3m
3 874 790	Sensor head 2:1 for IN 520, sensor cable 15m
3 874 880	Sensor head 10:1 for IN 520, sensor cable 3m
3 874 890	Sensor head 10:1 for IN 520, sensor cable 15m
3 874 740	Sensor head 2:1 for IN 530, sensor cable 3m
3 874 750	Sensor head 2:1 for IN 530, sensor cable 15m
3 874 760	Sensor head 10:1 for IN 530, sensor cable 3m
3 874 770	Sensor head 10:1 for IN 530, sensor cable 15m
3 848 790	Close focus lens (only for 10:1 optics, max. 85°C ambient temperature, not in combination with air purge, cooling / purging unit or 90° mirror)
3 834 370	Fixed mounting angle (for sensor head or air purge with sensor head 10:1)
3 834 380	Adjustable mounting angle (for sensor head or air purge with sensor head 10:1)
3 835 330	Air purge (for sensor head 10:1)
3 835 410	Air purge (for sensor head 2:1)
3 834 250	Fixed mounting angle (for air purge with sensor head 2:1)
3 834 260	Adjustable mounting angle (for air purge with sensor head 2:1)
3 835 340	90° mirror (sensor head 10:1)
3 852 290	DIN-rail-power supply NG DC; 100 ... 240 V AC, 50 ... 60 Hz ⇒ 24 V DC, 1 A
3 890 560	DA 6000-N: LED-digital display with possibility for pyrometer parameter setting; RS232 interface
3 890 570	DA 6000-N with RS485 interface
3 826 500	HT 6000: portable indicator and instrument for pyrometer parameter setting
3 852 440	IMPAC Protocol converter RS485 ⇔ Profibus-DP (max. 1 instrument)
3 852 460	IMPAC Protocol converter RS485 ⇔ Profibus-DP (max. 32 instruments)

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